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IN THIS ISSUE

AGRICULTURE IN GUAM

AGRICULTURE AND FOOD IN THE NETHERLANDS

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AGRICULTURE IN GUAM . . . . .

By R. G. Oakley*

The little tropical island of Guam became a possession of the United States following a treaty with Spain in 1899. It afterward became a Naval Station and so remained until captured by the Japanese on December 10, 1941. During the interim the Naval Government on the island took steps to develop its agriculture with a view to making the people self-sustaining; yet the agricultural possibilities were not fully explored in the program of work conducted there. The geographical isolation of Guam contributed somewhat to this lack of exploration, as did a host of other factors. Distances to other communication centers were great, transportation facilities were unfavorable to any extensive developments, and the land area of the island was too small to attract outside capital. As a consequence of these various factors, only copra for a flooded world market was ever exported.

The United States Office of Experiment Stations established an experimental station on the island in 1908 but terminated its activities there in 1932. Following the closing of the station, the Naval Government of Guam continued some of the station's former undertakings, although on a smaller scale, and also established an agricultural school.

The island of Guam lies approximately 1,500 miles south of Japan and some 700 miles north of the Equator. Its area includes approximately 202 square miles. The population, according to 1940 census figures,[1] totaled 23,067, of whom 21,502 were native Chamorro descendants of Polynesians, 787 were nonnative residents and their families, and 778 were members of the Naval establishment, Nonnative residents included employees of a cable company and Pan-American Airways and a few continental American merchants and farmers. There were also a few dozen aliens.

NATURAL FACTORS AFFECTING AGRICULTURE

Topography

Guam is of volcanic origin. Its southern part consists of rugged and rolling hills, with the exception of several small valleys and flat coastal areas through which streams flow in most cases (fig. 1). A narrow plateau area extends down the eastern shore for a distance of several miles. The altitude of the highest peak, located in the southern part of the island, is approximately 1,320 feet above sea level. Some of the plateau tableland is suitable for cultivation purposes, but for the most part the tillable land consists of the flat coastal and valley areas.

*Plant Quarantine Inspector, United States Bureau of Entomology and Plant Quarantine, stationed on Guam from June 13, 1937, to August 31, 1939.

[1] THOMPSON, LAURA M. GUAM AND ITS PEOPLE; A STUDY OF CULTURE CHANGE AND COLONIAL EDUCATION. 308 pp., illus. San Francisco and New York. 1941.

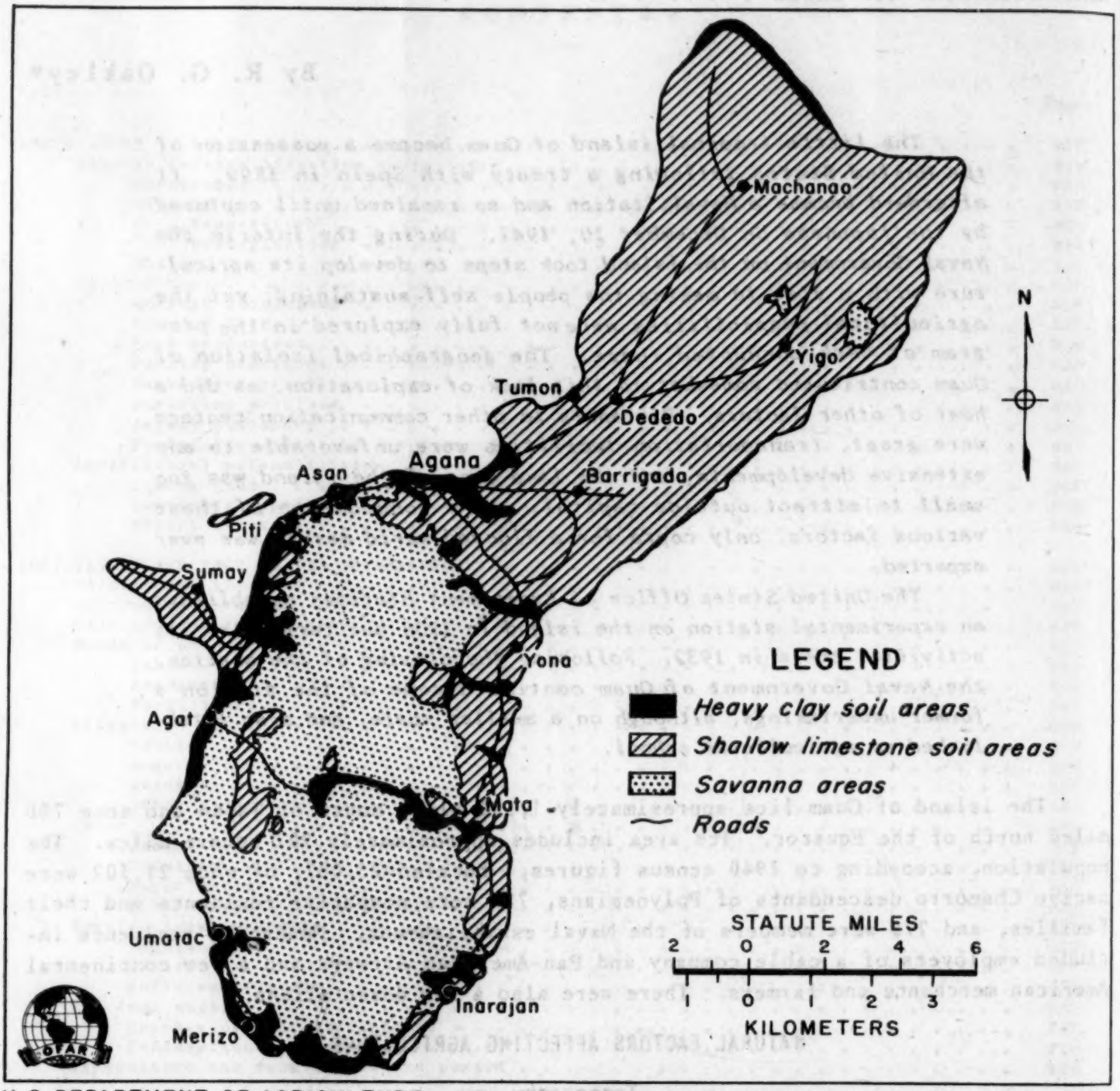

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FIGURE 1.—Map of Guam, showing approximate distribution of soil areas. (From geologic map by H. T. Stearns, with adaptations by the author.)

A region known as the "savannas," used for grazing purposes, occupies most of the southern half. It is largely covered with sword grass (*Miscanthus floridulus*), which is not suitable for forage.

The northern part of the island is a high plateau broken only by three hills. The greater part of this area is covered with forest or scrub growth, the remainder being devoted to coconut plantations and widely scattered bush cultivated areas. No streams are to be found there owing to the porous nature of the subsoil, which permits the rapid penetration of rainfall.

Climate

Temperature

The climate of Guam is tropical, with little seasonal variation in temperatures (fig. 2). Minimum temperatures from December through February may occasionally reach a low of 68° F. but rarely fall below 74° in other months. Mean maximum temperatures vary from about 86° to 89° F., with an occasional maximum of about 95°. The cooler months of the year are best for the production of certain crops, such as vegetables.

Precipitation

The rainfall in Guam, averaging about 95 inches annually, is unevenly distributed thus creating distinct dry and rainy seasons. Precipitation reaches a low ebb in February, April, or May (fig. 2), thus greatly retarding plant growth at that time. Weeds and grasses, including the sword grass in the savannas, which grow luxuriantly at other times, often fail to survive the drought, and the water problem for inhabitants and livestock in the plateau areas becomes acute. Cracks in the soil become common. Relief from the dry period comes in late June or early July, when rains in the form of intermittent showers begin to fall. The rainy season of frequent and sometimes heavy showers with occasional sunshine is under way by late July. The close proximity of typhoons to Guam from July to September is often followed by very heavy rainfall.

The distribution of rainfall, rather than of temperature, largely controls the planting of crops. In upland areas, this takes place in May, or early June, and again in late September, or early October. In this way the first crop can be harvested before the heavy rainfall comes, and the second planting is planned to reach maturity before the rainy season declines too much. For lowland areas planting schedules are more variable. They are used largely for rice in the wet season, or for other crops at other times.

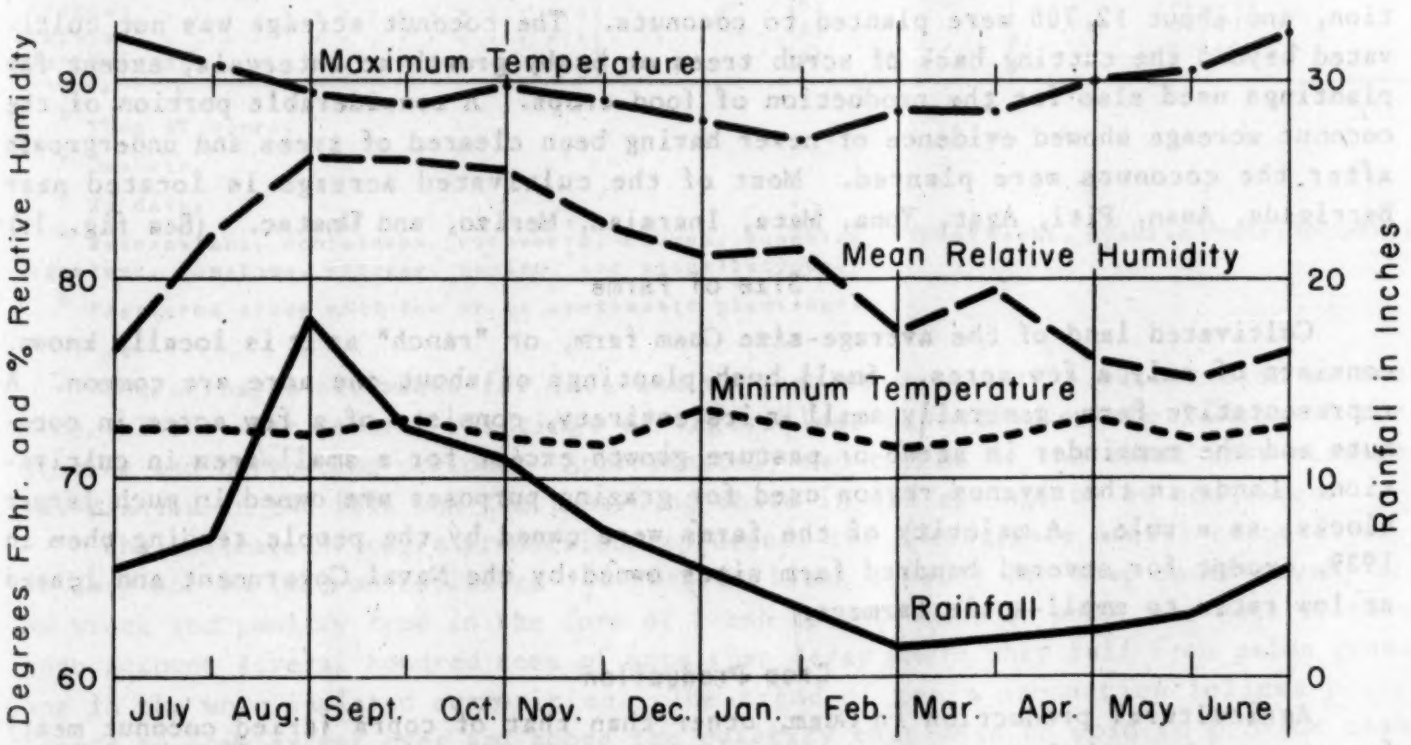

FIGURE 2.—Average precipitation, average maximum and minimum temperatures, and average relative humidity by months in Guam.

Soils

The soils of Guam are mostly of two general types - the heavy clay soils of the valleys and flat coastal areas and the porous limestone soils of the plateaus, which include the savannas. The clay soils are often only 6 or 7 inches in depth, whereas the limestone soils are generally much more shallow and are underlain with a subsoil of coral, some disintegrated and some not, of which outcroppings on the surface are common in some localities, even to the extent of almost covering a number of acres in spots. Mechanical cultivation equipment can be used successfully with the lowland soils, but generally large quantities of rocks must first be removed from limestone areas.

The limestone soils dry quickly after rains. The Guam farmer takes refuge under a banana leaf during a shower; then he continues with his cultivation when the rain ceases. These soils require frequent rains for best crop returns in contrast to the lowland soils. Both soils when newly cleared are generally quite fertile, but continued cropping of the limestone type soon depletes the supply of available nitrogen, phosphorus, and potash, necessitating abandonment of the land, under Guam practices, after a few years of cultivation. The favorable response of the older, cropped lowland soils to fertilizer applications[2] indicated that balanced fertilizers containing the three essentials were needed. An overabundant supply of manganese, which acts to prevent the proper assimilation of iron in plant growth, is often to be found, particularly in limestone soils. Former grassland soils have been known, in some cases, to yield disappointing returns when their cultivation is first attempted.[2]

AGRICULTURE

Acreage Cultivated

The land under some form of cultivation in Guam in 1939 was estimated at about 15,000 acres. Of this total, approximately 2,300 acres were under actual cultivation, and about 12,700 were planted to coconuts. The coconut acreage was not cultivated beyond the cutting back of scrub trees or bushy growth at intervals, except for plantings used also for the production of food crops. A considerable portion of the coconut acreage showed evidence of never having been cleared of trees and undergrowth after the coconuts were planted. Most of the cultivated acreage is located near Barrigada, Asan, Piti, Agat, Yona, Mata, Inarajan, Merizo, and Umatac. (See fig. 1.)

Size of Farms

Cultivated land of the average-size Guam farm, or "ranch" as it is locally known, consists of only a few acres. Small bush plantings of about one acre are common. A representative farm, generally small in its entirety, consists of a few acres in coconuts and the remainder in scrub or pasture growth except for a small area in cultivation. Lands in the savanna region used for grazing purposes are owned in much larger blocks, as a rule. A majority of the farms were owned by the people tending them in 1939, except for several hundred farm sites owned by the Naval Government and leased at low rates to small-scale farmers.

Crop Production

Agricultural production in Guam, other than that of copra (dried coconut meat) for export, is scaled to meet domestic needs. Most of the native inhabitants in 1939

[2] GUAM AGRICULTURAL EXPERIMENT STATION. ANNUAL REPORT, 1918. 61 pp., illus. Washington. 1919.

participated in one way or another in agricultural production; consequently, the volume of produce exchanged was small as compared with standards in continental United States for a population of similar size. The output of the average farm unit was small but was planned to keep the family supplied with food. The chief crop was corn, which was grown specifically for food purposes but was supplemented by small quantities of native fruits, root crops, and a few vegetables. The remaining surplus was then sold as a cash crop if a market existed.

On the basis of observations and assembled data, estimates were made in 1938, by the writer, of the annual acreage planted to various crops and of the production, including that of fruits. (See table 1.) These are believed to be fairly representative of the island's agriculture.

TABLE 1.-*Estimated acreage and production of specified crops in Guam, 1938*

CROP	ACREAGE	PRODUCTION (APPROXIMATE)
	Acres	*Pounds*
Coconuts	12,700	[1] 2,500
Corn	1,500	[2] 30,000
Rice	640	[2] 12,500
Sweetpotatoes	200	295,000
Taploca	150	500,000
Taro	100	665,000
Yams	50	200,000
Tobacco	5	(3)
Sugarcane	10	(3)
Vegetables[4]	150	(3)
Avocados	(5)	300,000
Bananas	(5)	917,000
Breadfruit	(5)	(3)
Lemons	(5)	20,000
Limes	(5)	10,000
Kapok	(5)	300
Mangoes	(5)	500,000
Oranges	(5)	20,000
Papayas	(5)	86,000
Tangerines	(5)	10,000

[1] Tons of copra.

[2] Bushels.

[3] No data.

[4] Watermelons, cantaloups, cucumbers, squash, pumpkins, string beans, Spanish beans, peppers, eggplant, tomatoes, cabbage, pepino, and miscellaneous.

[5] Scattered trees with few or no systematic plantings.

The acreages estimated for corn and vegetables were not in cultivation at one time. There were several plantings of vegetables, depending on the length of the growing and harvesting periods. Approximately two-thirds of the total corn acreage was planted in the fall and the remaining third in the spring, or at odd times.

The estimate of copra production represents the approximate annual exportation. It does not include an estimated 500 tons utilized locally for soap manufacture, or as stock and poultry feed in the form of fresh coconut meat or pulp, nor does it take into account several hundred tons of nuts that decay where they fall from palms growing in the more isolated communities. The trend of copra production follows price trends to some extent over and above the quantity that must be sold to provide cash for absolute necessities.

The acreages planted to vegetables each year and the yields therefrom are erratic, depending greatly on the emphasis placed on production by agricultural leaders. The acreage is also partly dependent upon an agency maintaining adequate stocks of seeds for sale at reasonably low prices. A program of vegetable production conducted in 1939 by the Department of Agriculture resulted in a considerable acreage increase over normal. Yields per acre from plantings were less than the averages on the mainland of the United States, owing mainly to lack of fertilization and insect-control practices.

The estimated production of kapok fiber represents quantities probably collected. The data do not reflect, however, actual production. Many farmers made little or no attempt from 1937 to 1939 to recover an unknown quantity of fiber produced by trees on their land boundaries. Possibly one or two thousand pounds of fiber were thus wasted as a result of low prices.

Farming Practices

A majority of the Guam farmers maintain their families in villages while they either live during weekdays in small huts on the farm or commute back and forth from the village to the farm. These daily commuters may travel as far as 8 miles one way, either walking or riding in carts drawn by carabaos, or cows. Most farming is accomplished with primitive tools consisting of a long-bladed knife, known as the machete, and a "fosino." The latter is a small hand-forged tool constructed and used as a shuffle hoe on a long handle. It is employed in clearing land for planting, in preparing the seedbed, and in cultivating the crop by the occasional removal of weeds with a simultaneous stirring of the surface soil. It also has a variety of other farm uses.

One-handled, iron, breaking plows are used in the rice fields, but they are rarely found elsewhere. Small harrows or cultivators, said to have been introduced in previous years and used extensively, were not in use from 1937 to 1939. A locally made harrow with wooden spikes was apparently used in all the fields, which had first been plowed and then flooded in preparation for setting out rice seedlings. The work animal for the plow and harrow is the carabao. One tractor was observed by the writer while in Guam.

The use of farm implements on the island has not been general for several reasons, the chief of which is probably the island economy. Also there is less need for implements on the small acreages cultivated by a family unit. Another factor contributing to a lack of implements results from the rocky formations of the limestone soils, which discourage the use of plows by the farmers, who are unaccustomed to using them, and who are not particularly interested in the first place.

The use of fertilizers, although they are often needed, has not been a part of Guam agricultural practices. The prices at which commercial fertilizers would have to be sold on the island because of high transportation costs have been beyond the economic reach of the farmers; so they have been obliged to continue, in accordance with long-established practices, to clear new land when the old became too depleted. The old land is then allowed to revert to forest growth for future clearings. Barnyard manure is almost unknown, because livestock are rarely concentrated for any length of time at any one place. Cover crops likewise have not found extensive use, probably because tools to cover them were not available.

Harvesting Practices

Harvesting problems in Guam are chiefly those concerned with copra, corn, and rice. In the case of copra, the farmer first chips out notches on the palm trunk to ease the task of climbing the palm to knock down ripe nuts. After collecting the nuts in a pile, he splits them with the machete in one or two blows per nut; then, with a blunt-nosed knife, he deftly sections and ejects the pulp, which is afterward spread on the ground for sun-drying. Several days' drying are required, during which the product must be guarded from rains. Mechanical drying equipment has not found a place in Guam economy as yet, although a few thatch-roofed sheds are in use.

High humidity and insect attacks must be reckoned with in the harvesting of corn. The first step in harvesting is to break over the stalk beneath the ear soon after the grain has filled out. This practice presumably prevents some grain decay, since it permits the water from frequent rains to drain off. The second step is to gather the ears when the grain has practically hardened. The third is to shell the corn as soon as possible. This shelling is accomplished by hand, because mechanical shellers of the types available are unsatisfactory in removing unhardened grain from the cob. The fourth step consists of spreading the grain on mats for drying in the sun for several days, during which time attacking weevils that would destroy the corn in a short time, if it were left in the field, are driven out. When well dried, the grain is placed in tight containers. These protect it from moisture absorption and subsequent decay, as well as from destructive attacks by storage insects.

The harvesting of rice is also accomplished by hand methods. When well cured in the field, the rice is cut and assembled at one point, where threshing is effected by variations of the flailing principle. The grain heads may be beat over a gasoline drum to shatter out the grain, or sheaths may be placed in thin layers on a slatted bamboo platform, where the trampling of barefooted children causes the grain to separate from the chaff and fall below.

Marketing Problems

Even when products have been harvested for the market, the problem of finding a buyer remains. If the product is rice, it must be sold in competition with imported rice, which can be bought at prices considerably below asserted costs of production for Guam rice. If the product is a vegetable, the nearest market is in the capital city of Agana up to 30 miles distant. Without assistance from the Government for transportation facilities, the farmer must sell to a dealer at very low prices, or pay public transportation for himself and goods to market at a cost often as great as the worth of the produce for sale. The Government has assisted in every way seemingly possible to adjust this situation but has not been altogether successful. These conditions have discouraged production, yet the consumer in Agana complains of being unable to buy products that often spoil on the farm.

Animal Husbandry

Livestock production in Guam is also on a small-scale basis. Except for a few individuals who maintained herds of cattle in 1939 comprising from a few dozen head up to a hundred or so, in the savanna grazing lands, the greater part of the livestock was produced by the small farmer. Most farms had a few cattle for consumption and for light work, and many of them also had a carabao or two for draft purposes.

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A few horses here and there were used for riding only, and practically all farms had a few chickens and pigs.

TABLE 2.—*Numbers of livestock in Guam*

TYPE	NUMBER	TYPE	NUMBER
Carabaos	1,090	Goats	606
Cattle	4,187	Chickens	106,458
Horses	101	Ducks	718
Swine	7,338	Turkeys	(1)

[1] Negligible.
Census of Livestock Raised in Guam, 1939.

The cattle in Guam in 1939 were mainly scrub stock and small in size. A portion of these were kept in pastures, or on the savannas, and the remainder were kept tethered unless they were being used for drawing carts. Little interest in cattle from the standpoint of milk production was evident. Attempts to improve the native cattle with imported stock from the United States mainland, such as Ayrshires, Holsteins, and Jerseys, were begun as early as 1905, but these efforts had met with little success. The introduced breeds had been unable to maintain themselves in the face of the adverse conditions prevalent, chief of which was the cattle-fever tick *(Boophilus annulatus)*. A few head of Indian cattle from the Philippine Islands, introduced in 1937 and 1939, showed some promise, however, of eventually becoming established. At the same time, slight progress was being made toward the control of the fever tick by dipping.

Swine on the island also consist of native scrub stock, with relatively few exceptions. For the most part they receive no feed other than swill, bananas, or coconut pulp. They are kept tethered, as a rule, as in the case of cattle. Numerous attempts to improve the stock over a 30-year period by introducing purebred strains of Berkshires and Duroc-Jerseys have met with little success for reasons resulting partly from the inability of the introduced breeds to survive the unfavorable climatic and other natural conditions and partly from false-economy practices of slaughtering the largest animals for festivities or for market.

While the poultry of Guam consists of predominantly native mongrel stock, it also includes a growing percentage of improved strains for egg production. Hens receive little or no grain feed and are, therefore, forced to subsist by themselves on the range, except for feedings of ripe coconut meat, or perhaps coconut cake in some cases.

The egg market is generously supplied with small ungraded eggs from December to July, but during the rainy season the egg production declines sharply. Available eggs of medium and large sizes were supplied by approximately a half-dozen producers from 1937 to 1939. Poultry production in Guam is popular despite numerous problems of combatting rodents and diseases.

Foodstuffs Available for Domestic Consumption

Corn provides the staple diet of a portion of the Guam inhabitants, but it is consumed in small amounts only by the majority of the people, who prefer rice. The

principal item in the diet, whether corn or rice, is supplemented by bananas; breadfruit, when in season; tubers; a few varieties of vegetables; meat; and fish. The local food supply represented by estimated yields (table 1) is sufficient for most food demands, except for canned salmon, rice, and a few miscellaneous items. Rice production on the island fills about one-third of the consumer demand; the remainder must be met by imports.

AGRICULTURAL POTENTIALITIES

Arable Land

The potential acreage in Guam capable of agricultural production, out of an estimated total of about 129,000 acres for the entire island, probably has not been surveyed. The author estimated in 1939 that there were about 16,000 acres of improved land on the island, and, in addition, the savanna lands were estimated at about 50,000 acres. Of the estimated 63,000 acres remaining, which consisted of timber and scrublands, a large percentage is unfit for other purposes because of its predominantly rocky nature or rough area. There are, however, several thousand acres of land that could be brought into profitable cultivation and several thousand more that could be developed into pasture land. The greater part of the potential acreage lies in the northern part of the island, where a water problem exists in the dry season, but this could be alleviated by the construction of additional storage facilities.

Estimates by the author and his associates in 1939 indicated that there were approximately 2,300 acres of lowland soils not in cultivation at that time, except for some coconut plantings, which could be cleared and utilized for either rice plantings during the rainy season or for vegetables during the months of lesser rainfall. The conclusion from studies made at the time was that irrigation water could be impounded for this acreage at relatively low costs, but that probably little or no impounded water could be had during May and June, except in one locality. Even without water facilities, the acreage would produce successfully through at least half the dry season.

Livestock Expansion

The outlook for livestock development in Guam is bright, although largely with respect to improvements of native scrub stock and to meet the needs of an expanding population. The absence of an export market for meat products, together with limitations placed on production by dry-weather pasturage conditions during April, May, and June of every year, would restrict any extensive expansion in the numbers of cattle and swine. The growth of the industry depends, however, somewhat on increased or decreased demands for meat products by the inhabitants of the island. The same principle also applies to some extent to poultry development.

Export Crops

The field in Guam for possible export crops, with the exception of copra, has not been explored. There are doubtless many tropical plants, such as tea, rubber, and cinchona, which might thrive under Guam conditions. Several varieties of cotton were grown successfully in plantings made by the former experimental station, and possibly certain types of staple now imported into the United

States from other countries could also be grown in Guam. The production of pineapples also offers favorable possibilities. The quality of the pineapples observed by the writer in Guam appeared to be unexcelled by Hawaiian varieties.

§

AGRICULTURE AND FOOD IN THE NETHERLANDS . . .

By Louise E. Butt*

The physical features of the Netherlands are ideal for a grassland economy and for the exacting requirements of market gardening, and these two branches of farming are typical of the country's agriculture. In few other countries of Europe is so large a proportion of the total area in natural pastures as in the Netherlands, where well over half the farming land is permanently in grass. Nor is there any other European country where vegetable, fruit, and bulb growing is carried on so extensively. Moreover, cropping and livestock raising are both pursued along very intensive lines, and as a result production is on a high level. Finally, emphasis on the quality of farm products, particularly for the export market, has further enhanced the good reputation of Dutch agriculture.

The position of the Netherlands as an important producer and exporter of certain crop specialties and livestock products has been maintained, however, only with the aid of imports of large quantities of feedstuffs, fertilizers, bread grain, and vegetable oilseeds. Under normal conditions, therefore, the agriculture of the country does not fully supply the food requirements of the population.

The circumstances of the war have forced the Dutch population to rely almost entirely upon domestic food resources. This has resulted in a reduction in the level of consumption which supports the peacetime preference of the Netherlands for specializing in the type of farming that makes the most of the country's natural advantages and for supplementing its requirements of foodstuffs on the foreign market.

The agricultural enterprise of the Netherlands had long been determined largely by the peculiar soil and topographical conditions of this low-lying country. With the outbreak of the present war, however, a departure from the traditional pattern of farming was necessitated by the loss of foreign markets and the need for increased supplies of domestically produced foodstuffs. For an understanding of wartime problems, a brief review of earlier developments is necessary together with a description of the structure of Dutch agriculture under normal pre-war conditions.

With the coming of the industrial era and the growth of a market for livestock products in the surrounding areas of Europe, the Netherlands developed a specialized farming enterprise which, while depending upon cheap feed imports from overseas, produced and exported important quantities of meat, cheese, butter, and eggs. Insofar as an active economic policy with regard to agriculture was evident before the depression years of the 1930's, it was directed chiefly toward maintaining the free entry of the necessary feed and bread grains and at building up a reputation for high quality for the domestic products going to foreign markets.

*Office of Foreign Agricultural Relations.

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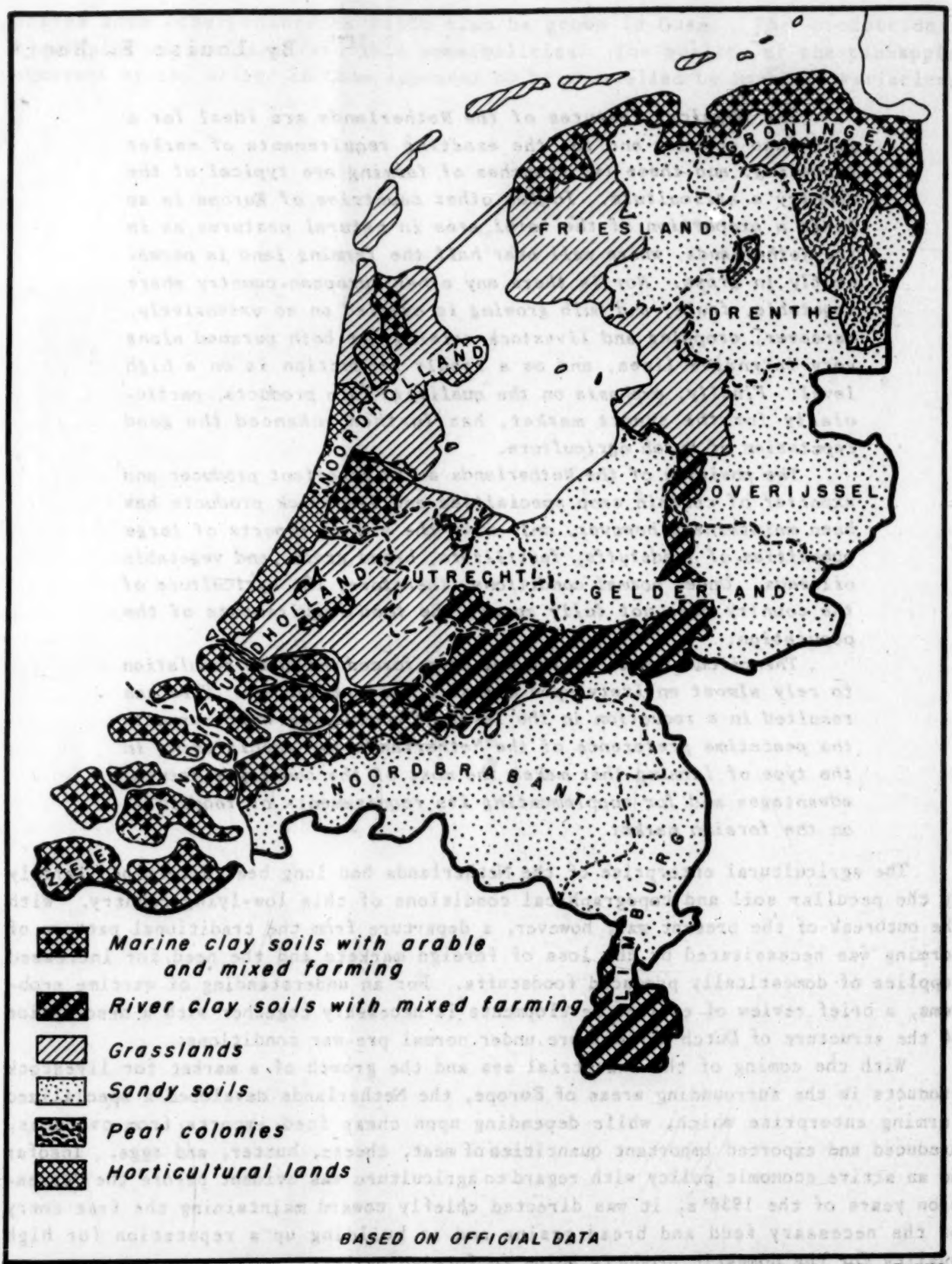

FIGURE 1.-Map of the Netherlands showing soils-land-use regions.

When the depression brought about a sharp reduction in both the demand for and the prices of these Dutch exports, the Government entered upon a program of protection for the farmer which, until the outbreak of war, characterized its agricultural policy. Import restrictions and price guaranties were aimed at assuring farmers of the best possible returns from the domestic market, and at the same time other measures, notably export subsidies, were undertaken to preserve as much as possible of the foreign market. The period 1933-37, upon which this survey of Netherlands agriculture is based, was thus one in which an attempt was being made to reduce the country's dependence upon imported supplies.

CLIMATE AND THE LAND

The climate of the Netherlands is maritime. The summers are cool and the winters mild; July temperatures average about 65° F. and January temperatures about 36°. A relatively long growing season permits the farmers in some parts of the country to utilize the land for second crops. Young cattle can be grazed in the open pasture as early as February (in certain areas throughout the year), and some field activity is possible on the farms even in the winter.

Precipitation, averaging 27 inches annually, may be considered as ample in view of the high ground-water level, considerable humidity of the air, and moderate temperatures in the growing season that reduce evaporation. An almost constant wind from the ocean blows over the country and is responsible for the fog, or mist, that covers the land in the winter. It serves also to dry up the water in the fields and to drive the windmills, which are widely used in draining the land. The rainfall and mist and, even more, the water present in the ground have helped to produce the extensive grasslands of the country that are the basis of Dutch agriculture.

The geological ages endowed the country with two basic kinds of soil. In the ice age the deposits of the glaciers and the glacial rivers formed the sandy soils of the eastern portion of the country. In later ages the deposits of the rivers and the sea formed the heavy clay soils of the western and northern Provinces, which, by dilligent draining and constant defense against the sea, the Dutch have converted into fertile crop and grass lands.

The surface of the Netherlands today bears witness to the natural and the human agencies which have formed it. Along the coast is a border of sand dunes, unfruitful, and covered with grasses, which only partially anchor them against the constant winds. Wooded areas in their lee look inland over the wide marshlands, much of which but for the dunes would be completely inundated. These marshes cover about one-third of the country and consist for the most part of a heavy and quite wet soil, which supports the pastures and croplands of the country. They are interlaced with numerous dykes and canals, which serve both for drainage and transportation.

East of the marshes, and covering most of the remaining area of the country, are the sand lands, barren and desolate in aspect, rolling, and largely treeless. One-fifth of their area is probably permanently unproductive, and pastures, poorer in quality than those of the marshland, cover much of the remainder.

AGRICULTURAL REGIONS

Soils and topograpby, briefly described in the preceding section, are the natural bases for six soils-land-use classes, which are distinguished in the official agricultural statistics of the Netherlands.

The first class is designated "marine clay with arable and mixed farming." These soils are of alluvial clay, which drainage and irrigation have made suitable for crop farming.

The "grasslands" have a very heavy clay soil and, while they provide some of the richest pasture areas in the world, are in general too boggy for cultivation.

"Sandy soils" as a whole lie high enough to enjoy the advantage of natural drainage, but they are of relatively poor quality. The soils of the "peat colonies" are of mixed sand and peat and are highly productive, whereas the "horticultural lands" have the light, loamy, and very wet soils that are best suited to the production of garden crops.

The eastern half of the country is, roughly, the region of the sand lands (fig. 1), and the various clay soils cover the western half, the river clays cutting northeastward into the heart of the sand lands.

While there is some variety in the agriculture of the sand lands, and while the peat colonies of Groningen and Drenthe have definite characteristics of their own, the entire eastern section forms a fairly uniform area, whose main variations grow out of topographical differences. Where marshlands predominate, pastures will be found, and where drainage or slight elevations in the land make arable farming feasible, the croplands of the section are located. Mixed farming, with pigs, cattle, rye, oats, and potatoes the chief products, is the predominant type of agriculture everywhere. Out of the entire section, however, only some 60 percent is in agricultural use. The rest is forest and waste land, that is, unreclaimed, and largely unreclaimable, heath or moor land.

The western section of the country presents a sharply contrasting picture. The clay soils are not only more productive but also are given to a greater variety of agricultural enterprise than is possible on the sand lands. Over the whole area mechanical drainage is a constant necessity, since most of the land is below sea level and would be inundated without the dykes and dunes along the coast.

The best arable land is in the marine-clay districts, covering the islands of Zeeland and Zuidholland and the coastal areas of Groningen and northern Friesland. These are the regions that produce wheat, barley, sugar beets, potatoes, legumes, flax, and field and garden seeds - the outstanding cash crops of Dutch agriculture. In these also mixed farming is common without being an integral part of the economy as it is in the sand lands. In many localities, however, the soil is too wet or too heavy for plowing and is therefore given over to pasture.

Such areas of the marine-clay region do not differ from the region designated as "grassland," where, except at an uneconomic outlay for drainage and reclamation, no arable farming is possible, and where the whole area is in pasture, with the possible exception of a little market gardening here and there. Western Friesland, Overijssel, and extensive areas in Noordholland, Zuidholland, and Utrecht constitute the grasslands. While cattle are the principal type of livestock in the greater part of these regions, hogs are also important in Utrecht and Zuidholland, and sheep on the Noordholland islands. Milk production for butter and cheese is by far the most important enterprise, although milk production for fresh consumption is found near large population centers. Stock raising is a specialty in certain districts, especially of Friesland, Gelderland, and Overijssel. Meat production in the grasslands is entirely secondary to dairying, but in many mixed-farming sections in the marine-clay regions the fattening of cattle, as well as of pigs, for slaughter is a common practice and provides a remunerative outlet for many of the products and byproducts of arable farming.

Mixed farming in the river-clay districts has its own characteristic aspect. These districts are located mainly in Gelderland and Zuid Limburg. In the past, such areas have been found suitable principally for cattle raising, since the frequent overflowing of the rivers made drainage difficult and unreliable. In more recent years, however, it has been found feasible to combine orchards with pasture land, and fruit production has thus become an important enterprise in these dairying sections. A great deal of market gardening is also carried on here.

Of special significance to Dutch agriculture are the horticultural lands, which cover a relatively small but extremely rich area in Zuidholland and Noordholland, just within the protective border of the dunes along the coast. Although horticulture is widely practiced elsewhere in the Netherlands, it is not of major importance in comparison with the other farming enterprises. In the horticultural lands, however, it is the predominant source of income.

The 6 soils-land-use regions of the Netherlands cut across the boundaries of the 11 Provinces to form 2, 3, or 4 divisions in each (except in Zeeland which is entirely marine clay). Each of these, in all 31 divisions, is fairly homogeneous as regards soil and agriculture (fig. 1). (For the total agricultural area of the divisions, number and size of farms, type of farm tenure, characteristic crops, and livestock numbers, see table 1.)

SIZE AND TENURE OF FARMS

There were 372,000 farms or "agricultural enterprises" (*bedrijfs*) in the Netherlands in 1930, according to the agricultural census of that year. Of these, however, over one-third were holdings of less than 2.5 acres, operated mainly on a part-time basis by farm laborers and by persons chiefly engaged in some nonagricultural work, and occupying only some 100,000 acres of land. Over 200,000 farms were between 2.5 and 50 acres in size and covered a total area of 3,000,000 acres, or 58 percent of all the agricultural land. Roughly 40 percent of the land was thus in some 27,000 farms of more than 50 acres in size.

The size of all farms of more than 2.5 acres in the Netherlands as a whole averaged 22 acres. In the eastern part of the country farms tended to be smaller and more numerous than in the west, where, in the marine-clay districts, the concentration of large arable farming enterprises offer a marked contrast to the family-size farms prevalent in the east.

The proportion of tenants among Dutch farmers is fairly high as compared with that found in other European countries. Over the country as a whole, on farms of more than 2.5 acres, there were, in 1930, 102,000 leaseholders or renters of various types operating 48 percent of the land, as against 132,000 owner operators, holding 50 percent. On the small holdings the proportion of owners was somewhat less. A considerable amount of land is held by absentee landlords as a form of capital investment. This has helped to keep at a relatively low level the minute subdivision of the land which in many other countries has accompanied peasant ownership and the laws and customs of inheritance. As a result, "strip farming" is not as widespread in the Netherlands as it is in many other European countries. Scattered landholdings, nevertheless, do exist and in some of the older farming regions present a serious problem, which has been the subject of Government action for some years.

Leaseholds are on the whole fairly simple. Most of them involve outright renting of the land for terms of 3 or 6 years at a rate fixed in advance for the period. Control of the rates has been undertaken by the Government, since the scarcity of farming land in relation to the demand for it has had an inflationary effect upon rents.

PROVINCE	SOIL-TYPE REGION	FARMS					LIVESTOCK PER 100 ACRES OF LAND					CHARACTERISTIC PRODUCTS
		AREA	NUMBER	AVERAGE SIZE	MEDIAN SIZE[1]	TENURE (PCT. OWNERS)	ALL CATTLE	MILK COWS	PIGS	CHICKENS	HORSES	
		1,000 acres	Thousands	Acres	Acres	Percent	Number	Number	Number	Number	Number	
Groningen	Marine clay	267	5.4	49	12-25	50						Wheat, barley, legumes, flax
	Grassland	38	1.1	35	25-50	26						Cattle, (butter, cheese),
	Sandy soil	98	4.7	21	12-25	72						Oats, potatoes, pigs, rye
	Peat colonies	82	2.3	36	25-50	63						Wheat, rye, oats, starch potatoes
	Total Province	485	13.5	36	12-25	58	30	17	11	201	6	
Friesland	Marine clay	131	4.9	27	2.5-12	20						Potatoes, wheat, barley, sugar beets, cattle
	Grassland	261	6.4	41	25-50	30						Cattle(butter, cheese, breading)
	Sandy soil	215	10.9	20	2.5-12	54						Rye, oats, potatoes, pigs
	Total Province	607	22.2	27	12-25	39	68	39	13	130	4	
Drenthe	Sandy soil	231	12.6	18	12-25	56						Rye, oats, potatoes, pigs, cattle(breeding)
	Peat colonies	121	4.8	25	12-25	51						Rye, oats, starch potatoes; also wheat, sugar beets
	Total Province	352	17.4	20	12-25	55	47	25	34	332	6	
Overijssel	River clay	22	.9	24	12-25	66						Cattle(butter, cheese, breeding), orchards
	Grassland	152	6.9	22	12-25	56						Cattle(butter, cheese), hay; or rye, oats, potatoes
	Sandy soil	316	18.2	17	12-25	78						Cattle(dairy); also rye, oats, potatoes
	Total Province	490	26.0	19	12-25	72	63	34	38	672	6	
Gelderland	River clay	268	13.9	19	2.5-12	47						Cattle(dairy, fattening, breeding) horses & pigs, fruit & vegetable specialties
	Sandy soil	404	26.6	15	2.5-12	71						Rye, oats, potatoes, chickens, pigs, cattle
	Total Province	672	40.5	17	2.5-12	63	55	26	49	1,451	6	
Utrecht	River clay	31	.8	39	25-50	51						Cattle(farm cheese), fruit
	Grassland	137	4.1	33	25-50	53						Cattle(farm cheese, milk[2]), pigs
	Sandy soil	53	2.5	21	12-25	54						Cattle(farm cheese, milk[2]), pigs
	Total Province	221	7.4	31	12-25	53	75	46	56	766	4	
Noordholland	Marine clay	111	3.2	32	12-25	51						Wheat, barley, oats, legumes, sugar beets; cattle(dairy), vegetables
	Grassland	239	8.8	27	12-25	48						Cattle(cheese, butter, milk[2]), pigs, sheep
	Sandy soil	6	.3	19	12-25	31						Cattle(milk[2]), horticulture
	Horticultural	98	7.4	13	2.5-12	49						Cattle(cheese, butter), pigs, vegetables
	Total Province	454	19.7	23	12-25	49	50	32	19	326	4	
Zuidholland	Marine clay	217	7.0	31	2.5-12	36						Cattle(milk[2]), wheat, sugar beets, potatoes, legumes & flax
	Grassland	298	10.1	30	12-50	50						Cattle(farm cheese, milk[2]), fattening pigs, sheep, lambs, vegetables
	Horticultural	49	3.8	13	2.5-12	57						Cattle(milk,[2] cheese), bulbs, fancy vegetables
	Total Province	564	20.9	27	12-50	46	59	36	47	250	5	
Zeeland	Marine clay	350	11.2	31	12-50	41						Wheat, barley, sugar beets, potatoes, legumes, flax, cattle(fattening), horses
	Total Province	350	11.2	31	12-50	41	24	7	13	209	8	
Noordbrabant	Marine clay	107	3.0	36	12-50	30						Cattle(milk[3]), hay
	River clay	31	1.6	19	2.5-12	35						Cattle(dairy), orchards
	Grassland	14	.8	18	2.5-12	32						Cattle(dairy, fattening & breeding), pigs
	Sandy soil	547	29.7	18	12-25	69						Rye, oats, potatoes, fodder roots, cattle(dairy, fattening, breeding), pigs, chickens
	Total Province	699	35.1	20	12-25	63	48	23	34	701	6	
Limburg	River clay	116	7.9	15	2.5-12	46						Wheat, rye, oats, potatoes, cattle(butter, milk[2])
	Sandy soil	197	12.5	16	2.5-12	63						Rye, oats, potatoes, fodder roots, pigs, poultry
	Total Province	313	20.4	15	2.5-12	56	40	21	49	1,101	6	
All Netherlands		5,207	234.0	22	12-25	56	51	28	32	569	6	

[1] Range within which the median-size farm falls. [2] For consumption. [3] For consumption and industrial uses.

MEANS OF PRODUCTION

Labor

In 1930 there were 639,000 persons actively engaged in agriculture in the Netherlands. Of these, more than 300,000 were farm laborers, 80 percent of whom were entirely without land. Of the landed laborers mentioned in the preceding section, less than one-fourth had as much as 2.5 acres of land. Those laborers that were entirely landless had to subsist on their wages alone, with possibly some help in the form of gifts of farm or garden produce. While wages were extremely modest, they would still have provided a frugal living under conditions of full employment. Such conditions, however, were by no means realized, particularly after the depression of the early 1930's. Trade-union officials estimated shortly before the war that unemployment during the winter was as high as from 65 to 75 percent and during the summer months, possibly 5 or 10 percent. Unemployment compensation for agricultural laborers was provided by the Government for a maximum of 36 days between December and April, but relief beyond that point had to be obtained from public-assistance authorities.

Machinery

Although there are no statistics on the numbers or use of farm machines in the Netherlands from which to obtain a precise account of the situation, mechanization does not appear to be of great importance, except in the highly developed arable-farming districts of Zeeland and Groningen and possibly on the newly reclaimed lands of the Zuider Zee. This situation may be partly due to the preponderance of livestock and dairy farming and the relatively small area in arable farms. Another reason, especially for the scarcity of mechanical implements on small farms, may be found in the plentiful supply of both family and hired labor.

Large farm machinery is not appropriate for farming in the Netherlands. In most areas farms are too small for the economical use of such machinery. In a survey made by the Government in 1935 only 10 percent of the farmers investigated were found to own their threshers. Of the others, half used cooperatively owned machines, and half rented. This was in the highly developed Province of Groningen, which had farms of larger size. The dampness of the Dutch climate often makes it inadvisable to bind grain as soon as it is reaped, since it has to remain in the field to dry out after cutting. Reaper-binders and combines are therefore to a considerable extent unsuitable for Dutch conditions. In some parts of the country where farming is most important, it is difficult to use any of the heavier varieties of machinery, because the wet boggy soil will not support their weight. The many ditches in the marshlands also make the use of machinery more difficult.

Fertilizers

One of the important reasons for the high productivity of the soil in the Netherlands is the general and extensive use of commercial fertilizers, which per acre of total agricultural land was larger than in any other European country. Total utilization in the years 1933-37 averaged about 65,000 short tons of nitrogen, 95,000 of phosphoric acid, and 110,000 of potash, in terms of plant food. This was equivalent to approximately 25 pounds of nitrogen, 35 of phosphoric acid, and 45 pounds of potash per acre of land in agricultural use. The additional application of animal manure in pre-war years may have supplied as much as 160,000 tons of nitrogen, 40,000 tons of phosphoric acid, and 130,000 tons of potash.

LIVESTOCK

The backbone of Dutch agriculture has been its livestock industry. Since 55 percent of the total area in agricultural use is in grassland, much of which is not adapted to arable farming, and since natural conditions in the arable areas favor the production of various feed crops, such as rye and feed roots, it is clear that full returns from the Dutch soil can be reaped only with the aid of an extensive livestock population. Further economies are effected by utilizing for feed many of the by-products of arable farming, such as beet tops, husks, and, in years of surplus, potatoes.

While the produce of the domestic soil provided the basis for a flourishing livestock industry, the great demand of the industrial populations of western Europe for livestock products made it very profitable for the Dutch to exploit further their excellent natural facilities for raising livestock by importing the necessary additional feed at the relatively low prices of the world market. The approximate extent of this dependence upon imports of feeds will be discussed in a later section.

Cattle

Both cattle and pigs were important in the livestock industry, but the dairy herds were its mainstay. The production of cheese and of butter had long been among the famous industries of the Netherlands, whose exports of these commodities normally equaled domestic consumption. Beef and veal production, while of considerable importance, was in general secondary to dairy production, especially in the permanent grasslands, where dairying and the breeding of dairy cattle have always been the chief agricultural enterprise.

For at least half the year in the grasslands the cattle graze in the open and require no supplementary feeding. In the winter months stable feeding consists mainly of hay, in most areas the product of the farm itself; ensilage; and supplementary rations of concentrated feeds.

In the 5-year period 1933-37 cattle numbers in the Netherlands averaged some 2,700,000 head, of which almost 1,500,000 were dairy cows. There were three typical breeds of cattle. The most numerous and the best-known of the three was the Black and White Friesland or Holstein breed. Cows of this breed are the best for milking and were found throughout the dairying sections in the north and west of the country. The red and white *Maas-Rijn-Ijssel Vee*, usually called simply *Ijssel Vee* or M.R.Y. was the predominant and favorite breed in Overijssel, Gelderland, Limburg, and eastern Noordbrabant. A breed of black cattle with white faces, known as the Groninger *Blaarkop*, was raised in northwestern Groningen. This is principally a meat-producing breed that was not general elsewhere in the Netherlands, except in the Province of Zuidholland.

Both the Friesland Black and White and the Ijssel cattle have high milk yields. The average yield per cow in the Netherlands has been calculated at 8,000 pounds per year (compared with an average of 4,400 pounds in the United States). In some of the best areas a yield of 9,000 pounds is the average, while cows giving 14,000 to 16,000 pounds are not uncommon. Butterfat content, reckoned at 3.4 percent, may be compared with an average of almost 4 percent in the United States.

Dairy farming is normally most important in Friesland, where the grasslands occupy 70 percent of the total farming area, but it is also an integral part of the agriculture of Noordholland, Zuidholland, Utrecht, Overijssel, and Gelderland.

The Friesland breed of cattle enjoys a high reputation, and large numbers of young cattle are transported each year from that Province to other parts of the country for herd replacement. In the dairy factories of Friesland and Overijssel normally almost 60 percent of the butter made in the Netherlands was produced, whereas in Friesland alone was made roughly half the cheese manufactured in the country.

In the river-clay areas of Gelderland and Overijssel, along the Rhine, the Waal, and the Maas (Meuse) Rivers, dairying, stock breeding, and fattening formed part of a mixed-farming economy. Butter was the principal dairy product, and farm cheese was also made.

Most of Utrecht and half the adjoining Province of Zuidholland are covered with grasslands; dairying, combined with pig raising, was formerly the chief agricultural enterprise. The famous Gouda cheeses were produced by the farms of this region, where one-fourth of the country's cheese was made. During the long summer grazing season milking and cheese making twice a day provided full occupation for the farm families. In the winter months much of the reduced milk output went to the nearby population centers for direct consumption.

The well-known Edam cheeses were the chief product of the extensive grasslands of Noordholland, where 20 percent of the country's cheese was made. In the neighborhood of Amsterdam, milk for fresh consumption was also important. While cheese making on farms was not common here, the factories were small, and their equipment simple, by comparison with the modern installations found in Friesland.

Hogs

Hog raising before the war was so general all over the Netherlands that probably no farm and scarcely a farm laborer with a small plot of ground was without a pig. This extensive raising of hogs was a highly economical way of utilizing many of the products and byproducts of farming. Such produce varied from section to section over the country. In the cheese-making districts, already described, large quantities of whey were fed. In the butter-making districts of Noordbrabant, Limburg, and elsewhere in the sand lands, skim milk provided an important feed. In the arable farming districts, especially of the sand lands, rye, oats, and potatoes brought high returns when converted into pork.

Domestic feed, however, was not adequate to maintain the pig numbers that were profitably produced to meet the foreign and domestic demand for Dutch pork products. Large imports of corn and barley therefore supplemented domestic supplies of feed. More imported grain was fed in the western part of the country where the farms provided mainly whey. In the east feedstuffs consisted more substantially of farm produce, chiefly steamed potatoes mixed with skim milk. Here also, however, where large numbers of hogs were kept, imported grains supplemented the diet.

Of the 1,800,000 hogs that constituted the annual average in the years 1933-37, the largest number were in the sand lands of the eastern Provinces. The hogs most common to this section were of a lean and fairly light weight type and were bred for bacon. They were a cross between the "improved" German pig *(Veredeltes Landschwein)* and a native Dutch pig with a strain of Danish; a type which was developed in order to produce the bacon acceptable on the British market when fresh pork, which the Dutch formerly supplied, was excluded in 1926.

In the western farm-cheese country a larger and fatter pig was produced. This was a Dutch variety of the Yorkshire (large white) pig, which produced pork for fresh consumption and, when properly fattened, lard. It was intended primarily to supply

the domestic market. In this part of the country it was normally not unusual to find a hundred or more hogs on a farm, in marked contrast to the small numbers common elsewhere.

Chickens

Chickens were raised mainly for egg production, and fine eggs for the export market were a specialty of Dutch farming. Like hogs, chickens had long been kept on farms all over the country to help turn waste products to good account. As in the case of hogs, however, chicken numbers had long since outgrown the supply of domestic feedstuffs, and in the pre-war period a large quantity of feed grain for chickens was imported. With the exception of a few breeders who specialized in producing purebred stock, no poultry farmers, as such, were found. The entire enormous production of eggs for export and a considerable, though secondary, meat production were based on individual small-farm enterprises.

The most important breed in the Netherlands was the White Leghorn. There were also Rhode Island Reds, Barnevelds, Welsium, and North Holland Blues. The last-mentioned were bred for poultry meat, and the others, especially the Leghorns, were raised for eggs.

Other Livestock

Before the war there were some 600,000 sheep, 130,000 goats, and 300,000 horses in the Netherlands. Horses were in general use for farm work, averaging 12 per 100 acres of arable land over the country as a whole. Breeding had for many years been important in certain parts of the country, notably Friesland, Zeeland, and Gelderland, and the Netherlands was renowned for its breeds of heavy farm horses.

Sheep were normally raised for both meat and wool, a special breed having been developed by sheep farmers on the island of Texel through the crossing of native sheep with the English Lincoln. The resulting breed, called the Texel, produces a good quality of meat as well as excellent wool. The island of Texel and some of the grasslands of Noordholland were the chief centers for sheep raising, which was also found to some extent on the poorer pastures in the east.

Goats were of little importance, although for the poorest farmers, especially in time of depression, they were a valuable source of food. The goat population, however, was maintained chiefly by goat fanciers, who organized breeding societies in most of the Provinces, and goat-milk inspection was frequently carried on along with the inspection of cow's milk.

CROPS

Even in a discussion of field crops the outstanding claim of the livestock industry on Dutch agriculture has to be acknowledged, for over half the arable land in the pre-war years was devoted to the production of feed crops, in addition to which some part of the food crops produced was ultimately utilized for feed. The area in feed crops added to the area in grasslands was equal to 78 percent of the entire area in agricultural use. Thus only 22 percent of the farming land in the Netherlands remained for the direct production of food for human consumption. Intensive farming methods, however, produced among the highest yields per acre in Europe. In pre-war years, yields of grains, potatoes, and legumes in the Netherlands ranged from 20 to 60 percent above average yields for Europe as a whole (excluding Russia).

Grains

The largest crop area was in grain. Rye was the most extensively sown, and oats were also important, these two principal feed crops occupying nearly 15 percent of

the agricultural land. While rye has become a food crop since the outbreak of war, only an estimated 20 percent of the pre-war domestic production was used as bread grain. Wheat, the most important food grain, was second to rye and occupied 6 percent of the land in agricultural use. Domestic wheat provided approximately 35 percent of the pre-war wheat-flour requirements of the Dutch population.

The two principal wheat areas in the country are in the marine-clay-soil districts of Groningen and Zeeland. These two regions produced 65 percent of the total wheat crop in the pre-war period. In the peat colonies, running south from the marine-clay area in Groningen and extending through Drenthe, another 8 percent of the wheat was grown. Other important localities for wheat production are some of the polders (reclaimed marshlands) in Noordholland and Zuidholland, the southern part of Limburg, and the western part of Noordbrabant, bordering the Zeeland wheat area.

Both winter wheat and spring wheat are normally grown in the Netherlands, with winter wheat constituting 85 percent of the total crop. This is seeded from September to December and harvested in July or August.

Rye is the principal crop in the sandy-soil districts, which produced over 75 percent of the pre-war rye crop. The chief rye areas are in the eastern part of Noordbrabant, northern Limburg, Gelderland, Overijssel, Drenthe, and parts of Groningen, very little being grown in the western parts of the country, where the soil is suited to the production of more remunerative crops.

In normal times rye is used relatively little as a bread grain. The bulk of the crop remains on the farms where it is produced and is used there as feed for pigs, chickens, and cattle. It is almost entirely a winter-sown crop, being seeded in the late fall and harvested in July or early August. Feed crops, such as serradella, are sometimes grown with rye. These continue to grow after the rye is harvested, to be mown or grazed in the late fall. Frequently fodder turnips are planted as soon as the rye is harvested and pulled as they are needed for feed.

Barley is a more important feed grain than rye in the clay-soil areas, where most of it is grown. Groningen, Zeeland, and Noordholland formerly produced the bulk of the crop which, contrary to wheat and rye, is mainly a spring-sown grain. Small amounts are used in the brewing industry, for which, before the war, some special malt was also imported.

Oats have been almost as important a feed grain as rye in the Netherlands. The crop is spring-sown and produced mainly in the sandy soils of Noordbrabant and northern Limburg, Gelderland, Overijssel, and Drenthe. Groningen, an important producer of all the grains, contained, however, almost 20 percent of the total area in oats during the 5 years 1933-37.

Potatoes

Two principal kinds of potatoes are normally grown in the Netherlands; namely, the so-called "consumptie aardappeln" or potatoes for consumption as food and feed and the "fabrieksaardappeln" or starch potatoes, which are manufactured into starch, although these are not too unpalatable to be eaten or used for feed if necessary.

Potatoes for food and feed are grown extensively in nearly all parts of the country. The clay soils yield considerably more per acre than the sandy soils, but the crop is probably more important where the latter prevails and fewer other crops can so profitably be raised. Both Friesland and Zuidholland are renowned for the quality of their food potatoes, which were formerly in great demand both in foreign and domestic markets. Select seed potatoes were a specialty, and some 125,000

tons were exported annually before the war. The starch potatoes were grown almost entirely in the peat colonies, where a number of potato-starch factories were located.

Sugar Beets

An important pre-war crop in the Netherlands, though occupying less than 5 percent of the arable land, was the sugar beet. It was grown mainly in Zeeland and the adjacent clay-soil districts of Noordbrabant and Zuidholland. Groningen was also an important producer. Besides the high financial returns which it brings, the sugar beet is important as a rotation crop in the wheat areas.

Other Crops

Beans and peas are important in several localities and are normally exported in considerable quantity. Their cultivation is confined to the clay soils, where they are important as rotation crops. The greater part of the production is used for feed.

Certain industrial crops are normally of considerable significance to Dutch agriculture, especially in the clay-soil districts. The most important in point of area is flax, which is grown for fiber rather than for seed, and is found mainly in Zeeland and Groningen. The Groningen flax crop is generally processed in the localities in which it is produced, providing an important source of employment in those areas.

Of the so-called industrial seeds, the most important are colza or rape, mustard, caraway, and poppy. The clay soils of Groningen and Noordholland produce most of these crops. Field seeds, principally spinach, sugar beet, cabbage, onion, clover, and rye grass, are important products of the clay soils of Groningen, Zeeland, and Noordholland and before the war were exported in large quantities.

In addition to the large area in permanent and rotation grass, there was during 1933-37 a considerable acreage in feed roots, averaging 145,000 acres annually - an area exceeding that of any other crop except grain and potatoes. In addition to their importance for winter feeding was their usefulness in rotation, especially in areas where the sugar beet is not grown. Mangels were most extensively cultivated, and some kohlrabi and fodder carrots were grown.

Green-fodder crops, the product of rotation meadows, covered about 2.5 percent of the total agricultural land before the war. Half this area was in clover, mainly red clover growing both in the sand and the clay-soil districts. Alfalfa, while not generally cultivated, had some importance in Noordholland and Zeeland. The vetches, lupines, and fodder cabbages were the products mainly of the sandy soils of Gelderland, Noordbrabant, and Limburg.

HORTICULTURAL PRODUCTS

The total area under horticulture in 1933-37 averaged about 300,000 acres. Of this, 30 percent was in private gardens probably producing mainly vegetables, with some fruit and flowers. Commercial market gardens occupied something over 25 percent of the area, or more than 75,000 acres; fruit orchards about 30 percent, or 85,000 acres; and of the remaining area some 25,000 acres were in flower bulbs, 2,500 in flowers, and about 7,500 acres in nursery products. All these produced largely for the foreign market. The combined value of annual exports of vegetables, bulbs, nursery products, garden seed, and fresh fruits averaged over 60 million florins (about $37,000,000), or more than one-fourth the value of all agricultural exports.

Vegetables

Among the products of Dutch horticulture vegetables are outstanding. Before the war about a million short tons were produced annually, 35 to 40 percent being destined for export. Cabbages of many varieties, early potatoes, cauliflower, lettuce, beans, and peas were among the more important products of open-field cultivation, and cultivation under glass was directed chiefly to tomatoes and cucumbers, although out-of-season crops of many other kinds were also produced under glass. The total area under glass before the war was roughly 9,000 acres, of which about 2,000 were in fruit and 1,200 in flowers.

The principal areas for vegetable growing were, of course, the horticultural regions described in an earlier section. The country just north and east of the Hook of Holland was the single most important vegetable-growing district in the country, reaching as far inland as Rotterdam and Delft. In this district greenhouses, in normal times, were widely used.

In Noordholland vegetable cultivation is chiefly in open fields, and here the production of early potatoes, cabbages, onions, cauliflowers, etc., was carried on. A small district just north of Alkmaar, on the Noordholland Peninsula, won renown for its cabbages, which were harvested in the fall and placed in special cold-storage warehouses for marketing in the early spring. Another district, on the eastern side of the peninsula between Enkhuizen and Hoorn, was important for its early potatoes.

Fruits

Berry cultivation and orchards of apple, plum, pear, and cherry trees accounted for most of the 300,000 tons of domestic fruit consumed annually before the war and provided an export surplus of 25,000 tons, mainly in the form of fruit pulp. Fancy varieties of grapes grown under glass for the export market were a specialty of Dutch horticulture.

Bulbs and Flowers

Some 40,000 tons of bulbs and 2,000 tons of flowers were exported annually before the war, representing probably the greater part of total production. These famous and typically Dutch products were grown chiefly in a fairly restricted area around Rotterdam and Delft, although their cultivation had in the more recent years spread to other parts of the country as well. The value of bulb and flower exports before the war was roughly 10 percent greater than that of all vegetable exports.

THE FOOD SUPPLY

Degrees of Self-sufficiency

The production of butter, cheese, eggs, and pork for export, which in normal times was one of the principal pursuits of Dutch agriculturists, was made possible, as already indicated, only by the importation of large quantities of feeds. Foodstuffs, also, were imported to supplement the domestic food supply and to replace certain home-produced foods utilized for feed. Other types of foodstuffs, on the other hand, were exported. The net position of the country with regard to food supplies was thus the result of a fairly complicated system of production, trade, and utilization. In terms of energy, the average annual consumption of foodstuffs in the Netherlands in the period 1933-37 amounted to 9,100 billion calories, of which 6,300 billion calories, or 69 percent, were derived from foodstuffs produced solely from domestic resources.

The consumption of foods of animal origin provided some 2,700 billion calories, with production of these products on the basis of domestic feedstuffs alone providing 2,200 billion calories. This represented a net dependence upon imports, mainly in the form of feedstuffs, amounting to 17 percent. Imports of additional feedstuffs provided the basis for an export of nearly 800 billion calories of foodstuffs of animal origin, notably butter, hog fat, and cheese.

As for vegetable foodstuffs, domestic production provided 63 percent of the 6,400 billion calories consumed, the heaviest dependence being upon imported bread grains, which provided over 1,700 billion calories; and imported oilseeds added annually almost 800 billion calories to the debit side of the Dutch food balance. The principal counterbalancing exports were potatoes, alcoholic beverages, vegetables, and legumes.

Consumption by Food Groups

The Netherlands consumption of foodstuffs before the war was at a high level. About 30 percent of the total caloric intake of the population was contributed by foodstuffs of animal origin, of which the consumption of dairy products amounted to nearly one-half. Generally speaking, consumption of the more expensive foodstuffs of high nutritive quality, or which are given preference at higher levels of living, was not much below the top standards found for large population groups elsewhere in Europe. Thus the per capita intake of fruits and of vegetables was approximately 125 pounds each and of sugar, 75 pounds. According to the available statistics, consumption of meat and fish together totaled only 107 pounds - a level that is below the pre-war German standard and considerably below pre-war consumption in Denmark. Possibly, however, meat production and consumption were actually higher than indicated by the statistics. (See table 2.)

Consumption of breadstuffs and cereals for food, in terms of flour, did not quite reach 224 pounds per capita and thus was lower than in Germany and considerably lower than in France. Note should be taken that most of the bread flour appears to have been from wheat with very little rye consumed - another indication in that part of Europe of a relatively high standard of living. Consumption of potatoes, at 287 pounds per capita, was roughly midway between the higher consumption of Germany and the lower consumption in other parts of western Europe. Consumption of fats and oils for food, at 52 pounds per capita, was at one of the highest rates in Europe.

The total intake per capita of the population, on the basis of such statistics as can be derived from official data and other information, appears to indicate a daily per capita consumption of about 2,900 calories as an average for the period 1933-37.

AGRICULTURE AND FOOD IN THE WAR PERIOD

As it was indicated earlier, the agricultural enterprise in the Netherlands has been largely determined by the peculiar soil and topographical conditions of the country. The wartime conversion from a livestock-raising economy, dependent upon imports of feedstuffs, bread grain, and fat, to a self-sustaining agriculture, providing the country's entire food and feed supplies, could only be achieved within certain limits set by the natural environment. This of necessity resulted in a considerable decline in food supplies.

The two principal peacetime food deficits - in bread grain and fats - were made the first points of attack in the wartime agricultural plan. Pasture lands were plowed up, adding approximately 20 percent to the acreage in field crops, and many areas formerly planted to feed crops were converted to food production. The acreage

TABLE 2.—*Production and utilization of principal foodstuffs, in the Netherlands, 1933-37*

ITEM	PRODUCTION	SEED AND WASTE	NET TRADE (IMPORTS +, EXPORTS -)	NET SUPPLY	FEED	OTHER NONFOOD USE	GROSS	HUMAN CONSUMPTION	
								NET[1]	NET PER CAPITA[1]
	1,000 tons	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*Pounds*
Vegetable foodstuffs:									
Wheat	468	40	+651	1,079	55	16	1,008	756	178
Rye	516	44	+72	544	414	—	130	94	22
Barley	114	8	+336	442	353	61	28	19	4
Oats	360	26	+30	364	308	—	56	35	8
Corn	—	—	+1,101	1,101	1,045	55	1	1	(2)
Rice	—	—	+66	66	15	4	47	47	11
Buckwheat	(3)	—	+27	27	27	—	—	—	—
Other grains	(4)	—	+9	9	9	—	—	—	—
Prepared cereals	—	—	+8	8	—	—	8	6	1
Total grains	1,458	118	+2,300	3,640	2,226	136	1,278	958	224
Consumption potatoes	2,560	429	-318	1,813	595	—	1,218	1,218	287
Starch potatoes	819	47	-5	767	—	767	—	—	—
Total potatoes	3,379	476	-323	2,580	595	767	1,218	1,218	287
Dry legumes	161	16	-22	123	95	—	28	28	7
Sugar beets	1,869	—	—	1,869	—	1,869	—	—	—
Refined sugar	250	—	+68	318	—	—	318	318	75
Vegetables	1,002	—	-330	672	—	—	672	538	126
Fruits	327	—	+246	573	—	—	573	523	123
Nuts	12	—	+2	14	—	—	14	14	3
Animal foodstuffs:									
Beef and veal	151	—	+1	152	—	—	152	137	32
Pork	214	—	-40	174	—	—	174	156	37
Mutton and lamb	10	—	-2	8	—	—	8	7	2
Horse and other meat	5	—	-2	3	—	—	3	3	1
Poultry	29	—	-3	26	—	—	26	24	6
Edible offals	23	—	-2	21	—	—	21	19	4
Total meat	432	—	-48	384	—	—	384	346	82
Fish	235	—	-129	106	—	—	106	106	25
Butter	104	—	-45	59	—	—	59	59	14
Hog fat	61	—	-21	40	—	—	40	40	9
Other slaughter fats	8	—	+17	25	—	17	8	8	2
Vegetable oils	4	—	[5]+149	153	—	57	96	96	23
Marine oils	—	—	+29	29	—	11	18	18	4
Total fats and oils	177	—	+129	306	—	85	221	221	52
Eggs	139	—	-57	82	—	[6]2	80	80	[7]130
Cheese	133	—	-65	68	—	—	68	68	16
Milk	5,595	—	-5	5,590	255	[8]4,175	1,160	1,160	273
Skim milk	[9]2,381	—	—	2,381	1,688	[10]693	—	—	—

[1] Grains in terms of flour; vegetables and fruits with allowance for spoilage; meat with allowance for loss in weight at retail. [2] Less than 0.5 pound. [3] Less than 500 tons. [4] No data available. [5] 262,000 tons of imports of oilseeds in terms of oil, minus net exports of 113,000 tons of oil. [6] Eggs for setting. [7] Number of eggs. [8] Butter manufacture 2,768,000 tons; cheese manufacture 1,147,000 tons; evaporating and drying 260,000 tons. [9] 86 percent of milk used in butter manufacture. [10] 338,000 tons for cheese manufacture; 291,000 tons for evaporating and drying; 64,000 tons for casein manufacture.

Official statistics and estimates by Office of Foreign Agricultural Relations. Population used in computing per capita figures, 8,500,000.

in wheat was increased by some 20 percent, that of rye by nearly 40 percent, and still larger increases in the potato and vegetable acreages were effected. A special effort to increase the fat supply resulted in a substantial new acreage in rapeseed, which previously had been of no great importance.

Production has not kept pace with increased acreages in the case of most of these crops, with the exception, perhaps, of vegetables. This may be attributed to several circumstances brought about by wartime conditions but principally to the decline in the input of plant foods, made scarce by the fall in imports of commercial fertilizers, or their raw materials, and the decline in the quantity and quality of manure resulting from decreased livestock numbers and impoverished feed supplies.

Livestock numbers had to be limited to the amount of feed available after all grain and oilseed imports were cut off; after most of the domestic rye and barley crops, formerly used for feed, were converted to food use; and after the plowing up of pasture lands necessitated by the need for more cropland. Cattle numbers were reduced by 23 percent, milk cows by 17 percent, and hogs declined to approximately 30 percent of the pre-war totals.

Under these conditions the food supply in the Netherlands was not only reduced but substantially changed in character. Whereas the total caloric intake was lowered by from 20 to 25 percent from the pre-war level, the composition of the diet was altered by an increase in the consumption of potatoes, legumes, and fresh vegetables and a decrease in the consumption of breadstuffs, sugar, meat, fat, and dairy products. Rationing in the Netherlands, as in other countries, was aimed chiefly at regulating the consumption of the urban population, after permitting the farm population to retain fairly generous "allowances" of the foodstuffs which they produced. While under the conditions prevailing in the Netherlands this system resulted in a consumption level for the farm population probably not far below that of normal years, the consumption of the urban population, who constituted 80 percent of the total, may have been reduced by as much as 30 percent. Estimates indicate that during the marketing year 1943-44 the urban dietary level probably provided little more than 1,800 calories per day, on the basis of rations.

The reconstruction of Dutch agriculture on the pre-war basis will not be quickly or easily achieved. In the first place, it was part of a complicated economic system extending beyond the borders of the country and interdependent with the economic life of other countries; and, in the second place, it was based on a highly developed technical system whose reestablishment will take time and effort. A revival of foreign demand for relatively high priced types of products is one essential; the renewal of imports of the necessary feedstuffs is a second condition; and the restoration of the former productivity of the soil is a third. This will involve not only the return of plowed land to pasture, the rebuilding of the fertility of the soil through intensive input of plant food over a period of years, but probably also the drainage and reclamation of some areas of land that may be flooded before the retreat of occupying German forces.

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